National Aeronautics and Space Administration

NASA

GROUND SYSTEMS DEVELOPMENT & OPERATIONS

HIGHLIGHTS

2016 YEAR IN REVIEW

Team:

It is an exciting time in the Ground Systems Development and Operations (GSDO) Program!

We continue to push forward in our efforts to prepare Kennedy Space Center facilities and infrastructure to support Exploration Mission 1 (EM-1), the first integrated flight of the Space Launch System (SLS) and the Orion spacecraft. Our ground operations team is engineering the capability to successfully test, check out, and launch the SLS/Orion, and also recover the Orion crew module when it lands in the Pacific Ocean at the end of the mission. At the same time we have begun planning for EM-2, which will be the first crewed flight of Orion atop the SLS rocket on a deep space destination.

Last year, we accomplished so much toward our mission. New work platforms were installed in High Bay 3 of the Vehicle Assembly Building, and we completed modifications to crawler- transporter 2 (CT2) that have extended its useful life for 50 additional years. Upgrades continue to take place at Launch Pad 39B, including the installation of a new flame trench and flame deflector.

We are busy testing our launch accessories at the Launch Equipment Test Facility (LETF) and have already delivered several to the Mobile Launcher (ML) Parksite for installation. We ramped up installation of ground support equipment in the ML, and we have modernized and modified the Multi-Payload Processing Facility (MPPF) and the Rotation Processing and Surge Facility (RPSF) to support the new spacecraft and the modified boosters. The development and testing of our command and control system software and our communications systems are well underway. Launch countdown planning and launch team building also made a lot of progress in 2016. Finally, we held the first GSDO Mission Requirements Review in November 2016, marking the commencement of EM-2 work for the next phase of our agency's ambitious Journey to Mars.

This Year in Review publication is an opportunity to reflect back on our progress in 2016. While there is plenty of hard work ahead, I am extremely proud of the progress we've made this year. All of these accomplishments are a direct result of the skill, commitment and dedication of this outstanding team.

I could not be more proud!

Michael J. Bolger
Manager, Ground Systems Development and Operations Program

JANUARY

AFT SKIRT MOVES TO RPSF

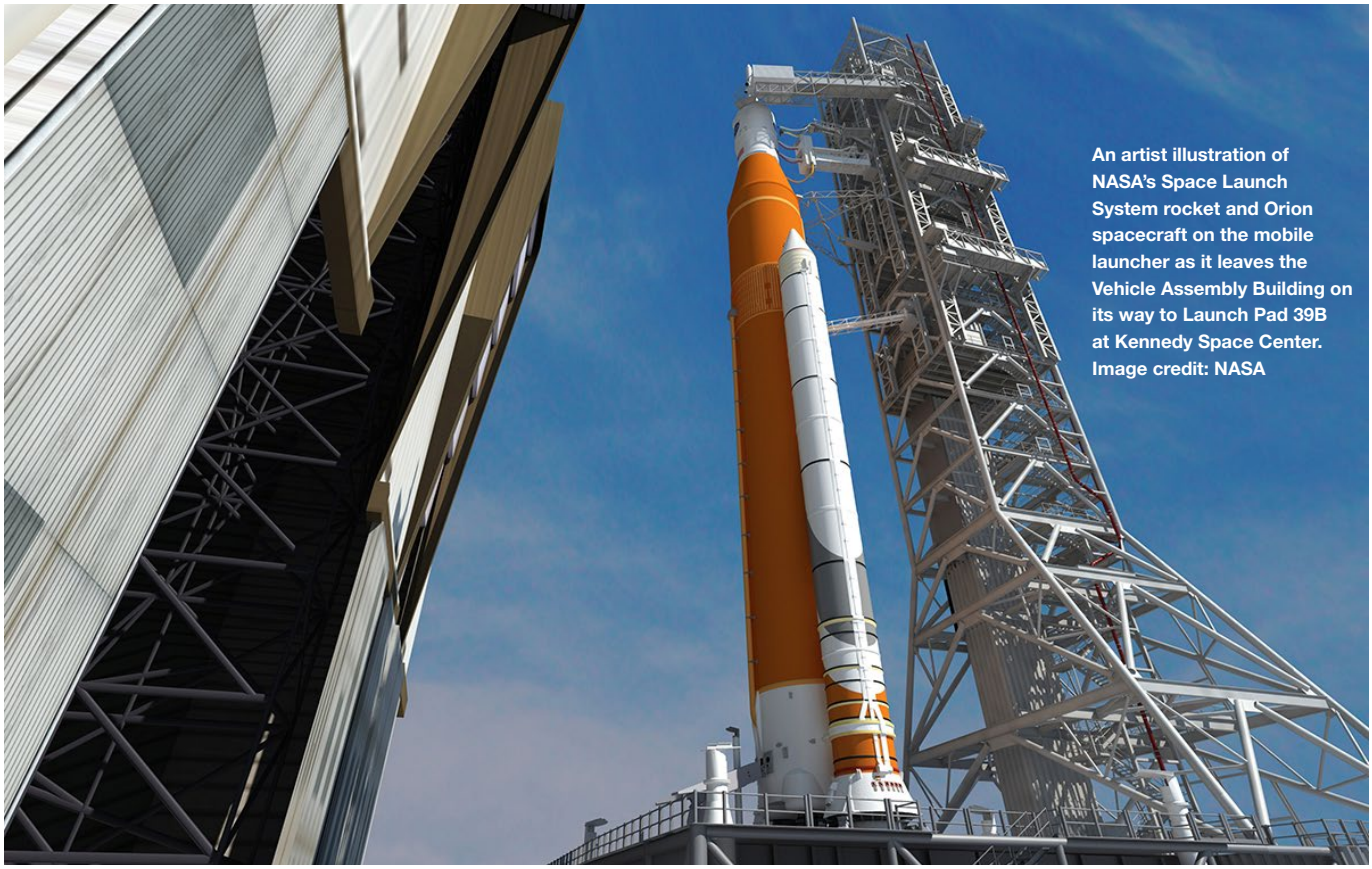
An aft skirt similar to one that will be used on a solid rocket booster (SRB) for NASA's Space Launch System rocket, was transported by NASA and Jacobs engineers and technicians on the Test and Operations Support Contract on Jan. 20, to the Rotation, Processing and Surge Facility (RPSF) at Kennedy Space Center in Florida. At the RPSF, the aft skirt will be inspected and undergo limited processing to prepare for SRB pathfinder operations. The pathfinder operations will help to test recent upgrades to the RPSF facility as the center prepares for Exploration Mission-1, deep-space missions, and the journey to Mars. Photo credit: NASA/Bill White

JANUARY

FIRST HALF OF G LEVEL PLATFORM ARRIVES

Technicians assist as an oversized, heavy transport trailer, carrying the first half of the “G” level work platforms, proceeds toward the west side parking area of the Vehicle Assembly Building at NASA’s Kennedy Space Center in Florida. The platform was transported Jan. 6, from Sauer Co. in Oak Hill, Florida. The Ground Systems Development and Operations Program is overseeing upgrades and modifications to High Bay 3 to support processing of NASA’s Space Launch System and Orion spacecraft, and other exploration vehicles. Photo credit: NASA/Ben Smegelsky

JANUARY



An artist illustration of NASA's Space Launch System rocket and Orion spacecraft on the mobile launcher as it leaves the Vehicle Assembly Building on its way to Launch Pad 39B at Kennedy Space Center. Image credit: NASA

CRITICAL DESIGN REVIEW MARKS PROGRESS FOR JOURNEY TO MARS

NASA's Ground Systems Development and Operations Program (GSDO) has successfully completed its critical design review, on the path to preparing for the agency's Journey to Mars.

Members of the review board completed their in-depth assessment of the plans for the facilities and ground support systems at Kennedy Space Center in Florida that will be needed to process NASA's Space Launch System (SLS) rocket and Orion spacecraft for deep-space exploration missions. A Standing Review Board composed of aerospace experts from NASA and industry also will provide an independent assessment. Results of the review process will be briefed to senior agency officials in the coming months as the last step in the process.

"The completion of this review represents a critical milestone for the GSDO team that clearly demonstrates we are on track with the launch site upgrades required to support SLS and Orion test, checkout and launch in 2018," said Mike Bolger, GSDO program manager.

The SLS will be the most powerful rocket in the world and will launch astronauts in the agency's Orion spacecraft to destinations beyond Earth's orbit. Key elements of Kennedy's launch infrastructure will support a new era of human exploration on the journey to Mars.

Progress already can be seen around the center with work currently underway to prepare for the arrival of SLS and Orion.

To read the complete story, visit
http://www.nasa.gov/feature/gsdo-critical-design-review-marks-progress-for-nasas-journey-to-mars

FEBRUARY

BLACKWELL-THOMPSON NAMED LAUNCH DIRECTOR FOR SLS/ORION

The first flight of a Space Launch System, or SLS, rocket carrying the Orion spacecraft on an unpiloted mission to lunar orbit and back now has its launch director. Veteran spaceflight engineer Charlie Blackwell-Thompson will helm the launch team at NASA's Kennedy Space Center for the first flight test of a space system designed to carry astronauts into deep space before making a landmark journey to Mars.

Her selection as launch director means she will be the first woman to oversee a NASA liftoff and launch team. "A couple of firsts here all make me smile," Blackwell-Thompson said. "First launch director for the world's most powerful rocket -- that's humbling. And I am honored to be the first female launch director at Kennedy Space Center. So many amazing women that have contributed to human spaceflight, and they blazed the trail for all of us. I feel extremely blessed. I also know being the launch director comes with a whole lot of responsibility. I have a healthy respect for just how important this job is."

That first flight, known as Exploration Mission-1, or EM-1, will be an important flight test before carrying astronauts, and Blackwell-Thompson said there is no shortage of planning, simulations and adaptations ahead in the next three years as the American space agency gets ready to launch the first rocket powerful enough to enable human exploration into deep space.

"I remember when I walked into Firing Room 1 during a tour before I was hired many years ago, and one of the guys said if you take this job you will sit here at this console," Blackwell-Thompson said. "I was amazed at even being in the firing room, and the thought of being on the launch team then was unbelievable. So take that feeling and fast forward to getting the opportunity to walk into Firing Room 1 as the launch director for the SLS/Orion vehicle; that is something very special."

That tour led to a post with The Boeing Company as a payload flight software engineer that saw Blackwell-Thompson lead test and avionics checkouts for numerous spacecraft and systems that were later launched on the space shuttle. She joined NASA as a test director in 2004 and oversaw different aspects of the launch countdown for launches from 2005 until the shuttle fleet was retired in 2011.

A holder of numerous patents, Blackwell-Thompson has worked in NASA's Ground Systems Development and Operations Program as launch and countdown planning has developed for the SLS and Orion systems.

To read the complete story, visit http://www.nasa.gov/feature/blackwell-thompson-named-launch-director-for-slsorion

SOLID ROCKET BOOSTER PATHFINDER SEGMENT LIFT IN RPSF

FEBRUARY

Inside the Rotation, Processing and Surge Facility high bay at Kennedy Space Center in Florida, a crane and lifting mechanism are used to lift the first pathfinder, or test version, of solid rocket booster segments for NASA's Space Launch System rocket and move it away from the railcar Feb. 25. The booster segment will be lifted into the vertical position and secured in a test stand. The Ground Systems Development and Operations Program and Jacobs Engineering, on the Test and Operations Support Contract, will conduct a series of lifts, moves and stacking operations using the booster segments, which are inert, to prepare for Exploration Mission-1, deep-space missions and the journey to Mars. The pathfinder boosters arrived at Kennedy from Orbital ATK in Utah aboard an Iowa Northern train contracted by Goodloe Transportation of Chicago.
Photo credit: NASA/Ben Smegelsky

MARCH

CRAWLER-TRANSPORTER 2 TAKES TRIP TO LAUNCH PAD 39B

NASA's crawler-transporter 2 (CT-2) began its trek March 22 from the Vehicle Assembly Building (VAB) to Launch Pad 39B at Kennedy Space Center to test recently completed upgrades and modifications to support NASA's journey to Mars. CT-2 moved along the crawlerway at no more than one mile per hour and completed its journey to the pad after numerous scheduled stops along the way to verify the operation of the completed upgrades. The Ground Systems Development and Operations Program oversaw upgrades to the crawler in the VAB. The crawler will carry the mobile launcher with Orion atop the SLS rocket to Pad 39B for Exploration Mission 1. CT-2 is one of two crawlers built in 1965 for the Apollo program and also carried space shuttles for 30 years. CT-1 and CT-2 have travelled more than 5,000 miles during their 50-plus years in service for NASA's space programs. Photo credit: NASA/Kim Shiflett

MARCH

Inside the Rotation, Processing and Surge Facility high bay at NASA's Kennedy Space Center in Florida, engineers and technicians with Jacobs Engineering on the Test and Operations Support Contract monitor the progress as two cranes are used in tandem to lift the first of two pathfinders, or test versions, of solid rocket booster segments for NASA's SLS rocket. Photo credit: NASA/Ben Smegelsky

PATHFINDER OPERATIONS WILL PAVE WAY FOR SPACE LAUNCH SYSTEM PROCESSING

NASA's Space Launch System (SLS) rocket will be the most powerful in the world, and is the vehicle that will launch humans beyond low-Earth orbit and on to deep space destinations as the agency continues its Journey to Mars. The Ground Systems Development and Operations Program at Kennedy Space Center is preparing its workforce, facilities and ground support equipment to handle the processing requirements of the SLS rocket and Orion spacecraft for its launch. A team of NASA engineers and Jacobs technicians and crane operators on the Test and Operations Support Contract are preparing for Exploration Mission 1 (EM-1) processing activities. Experienced personnel are leading the preparation effort using pathfinders, or test versions, of an aft skirt and two inert segments of a solid rocket booster (SRB) inside the Rotation, Processing and Surge Facility (RPSF) at Kennedy Space Center in Florida.

The aft skirt and booster segments are similar to those that will be used on the Space Launch System rocket. At launch, the twin SRBs will provide more than 75 percent of the total SLS thrust and operate for about two minutes before separating from the core stage. The aft skirt is at the base of the booster and contains the system that will steer the booster nozzles.

"The RPSF was used for space shuttle booster segments," said acting NASA Integrated Operations Flow Manager David Diaz. "Upgrades and modification to the heritage test stands and work platforms recently were completed to accommodate the new aft booster assembly, and particularly the longer nozzle."

The pathfinder operations are performed to help verify that the upgrades and modifications completed in the RPSF will support processing requirements for the aft skirt, SRB segments and the integrated aft booster assembly to ensure a smooth liftoff at launch.

To read the complete story, visit

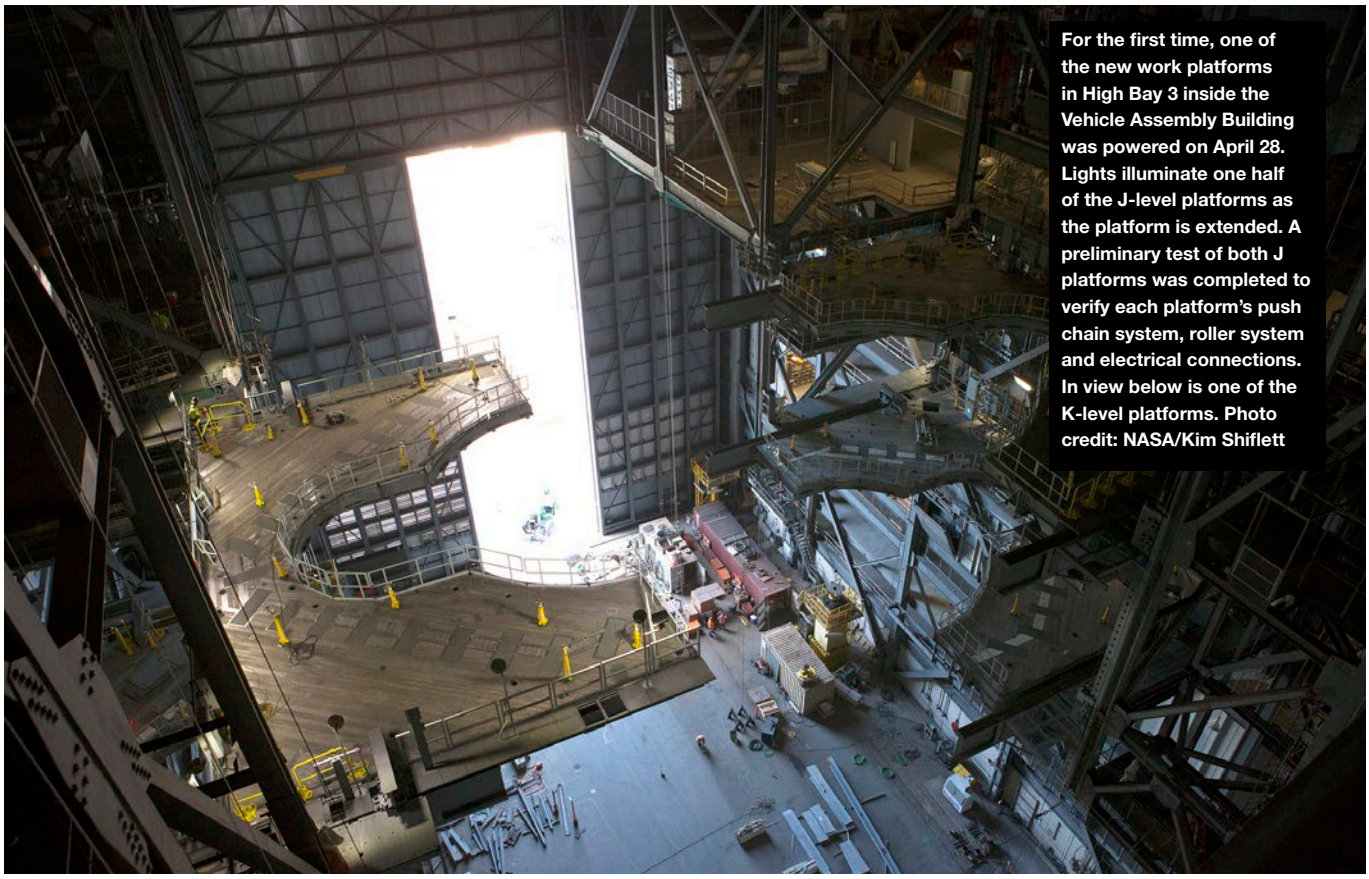
http://www.nasa.gov/feature/pathfinder-operations-will-pave-way-for-space-launch-system-processing

FIT CHECK OF NEW LH2 TRANSFER FLEX HOSE

APRIL

Engineers and technicians on the Test and Operations Support Contract go over procedures with liquid hydrogen (LH2) provider PRAXAIR April 28 to prepare for a fit check of the new LH2 transfer flex hose at Kennedy Space Center's Launch Pad 39B. LH2 provider PRAXAIR connected the transfer flex hose from its LH2 truck to the LH2 tanker to confirm that the hose fits and functions properly. The Ground Systems Development and Operations Program is overseeing upgrades and modifications to Pad 39B to support processing of the first integrated launch of the Space Launch System rocket and Orion spacecraft for Exploration Mission 1 and NASA's journey to Mars.
Photo credit: NASA/Frankie Martin

FIRST WORK PLATFORMS TESTED IN VAB FOR SPACE LAUNCH SYSTEM



For the first time, one of the new work platforms in High Bay 3 inside the Vehicle Assembly Building was powered on April 28. Lights illuminate one half of the J-level platforms as the platform is extended. A preliminary test of both J platforms was completed to verify each platform's push chain system, roller system and electrical connections. In view below is one of the K-level platforms. Photo credit: NASA/Kim Shiflett

APRIL

Kennedy Space Center is one power step closer to processing the agency's Space Launch System (SLS) for its first flight, Exploration Mission 1 (EM-1) and NASA's journey to Mars. During a preliminary test April 28, the two J-level work platforms installed on the north and south sides of Vehicle Assembly Building High Bay 3, where the SLS will be prepared for launch, were successfully activated to test their functionality and simulate how they will surround the massive rocket on the mobile launcher.

"It was an amazing sight to look down and watch as the platform smoothly extended out into the open air of High Bay 3," said Mike Bolger, Ground Systems Development and Operations Program (GSDO) manager. "As each half of the J platforms slowly extended, I couldn't help but think forward to the day when the SLS core stage and boosters will fill the void between the platform halves."

The J-level work platforms are just one of 10 levels of platforms that will surround the SLS rocket and Orion spacecraft in the high bay. The platforms will extend and retract and will have the capability to be adjusted up or down as required to give engineers and technicians access to various areas of the giant rocket, twin solid rocket boosters, Orion and its launch abort system during processing and testing.

Each of the platform halves are about 62 feet wide and 38 feet long and weigh between 300,000 and 325,000 pounds. The J-level platforms are located about 112 feet above the VAB floor, or nearly 11 stories high, and will provide access to the SLS booster.

As additional platforms are installed in High Bay 3, they will undergo the same testing to ensure all of the platforms are ready for the first launch.

To read the complete story, visit http://www.nasa.gov/feature/first-work-platforms-powered-on-and-tested-in-vehicle-assembly-building-for-space-launch-0

Construction workers with J.P. Donovan of Rockledge, Florida, prepare to attach new heat-resistant bricks to one of the concrete walls on the north side of the flame trench at Launch Pad 39B. The Pad B flame trench is being refurbished to support the launch of NASA's Space Launch System rocket. The Ground Systems Development and Operations (GSDO) Program at Kennedy is helping transform the space center into a multi-user spaceport and prepare for Exploration Mission 1, deep-space missions, and the journey to Mars. Photo credit: NASA/Kim Shiflett

UPGRADES TO LAUNCH PAD 39B FLAME TRENCH WILL SUPPORT SPACE LAUNCH SYSTEM ROCKET

NASA's Space Launch System (SLS) rocket and Orion spacecraft will roar into deep space from Launch Pad 39B at the agency's Kennedy Space Center in Florida. Before the most powerful rocket in the world takes flight, the Ground Systems Development and Operations (GSDO) Program continues making significant upgrades and modifications to the historic pad to accommodate the new rocket's shape and size. Exploration Mission 1 (EM-1) will be the first of many missions of SLS and Orion as the agency prepares for its journey to Mars.

In June 2015, NASA awarded a contract to J.P. Donovan Construction of Rockledge, Florida, to upgrade the flame trench and provide a new flame deflector. This system is critical to safely containing the plume exhaust from the massive rocket during launch. Construction workers have been busy, removing old adhesive material and preparing the walls on the north side of the trench for brick installation.

Construction workers now are preparing the north side of the flame trench to withstand temperatures of up to 2,000 degrees Fahrenheit at launch of the rocket's engines and solid rocket boosters. Approximately 100,000 heat-resistant bricks, in three different sizes, will be secured to the walls using bonding mortar in combination with adhesive anchors. The new flame deflector will be positioned about six feet south of the shuttle-era flame deflector's position. The north side of the deflector will be protected by a NASA standard coating. The south side of the deflector will not be slanted and will have no lining. The new design will provide easier access for inspection, maintenance and repair.

The two side flame deflectors, repurposed from space shuttle launches, will be refurbished and reinstalled at pad level on either side of the flame trench to help reduce damage to the pad and SLS rocket.

To read the complete story, visit

http://www.nasa.gov/feature/upgrades-to-launch-pad-39b-flame-trench-will-support-space-launch-system-rocket

MAY

PLATFORM H SOUTH INSTALLED IN HIGH BAY 3

MAY

A crane carefully lowers Platform H South into position May 26, 2016, for installation inside High Bay 3 of the Vehicle Assembly Building at NASA's Kennedy Space Center in Florida. In view below Platform H are platforms J and K. Platform H will allow technicians and engineers to reach the Space Launch System booster for mating of the forward/center segment to the center/center segment, as well as cable routing and booster closeouts. It is the third of 10 levels of work platforms that will surround and provide access to the Space Launch System rocket and Orion spacecraft for Exploration Mission 1. The Ground Systems Development and Operations Program is overseeing upgrades and modifications to VAB High Bay 3, including installation of the new work platforms, to prepare for NASA's Journey to Mars. Photo credit: NASA/Kim Shiflett

TAIL SERVICE MAST UMBILICALS PREPARED TO SUPPORT NASA'S JOURNEY TO MARS

A crane lowers a segment of one of the Tail Service Mast Umbilicals to its other segment at Precision Fabrication & Cleaning in Cocoa, Florida. Photo credit: NASA/Bill White

Several connections, called launch umbilicals, will connect from the mobile launcher tower and provide power, communications, coolant and fuel to NASA's Space Launch System (SLS) rocket and Orion spacecraft for their first integrated mission. Among them are two umbilicals called tail service mast umbilicals (TSMUs). They are being cleaned and assembled at Precision Fabrication Cleaning in Cocoa, Florida, before they are transported to the agency's Kennedy Space Center in Florida for testing.

Technicians are cleaning the two segments of each umbilical to remove any dirt or debris that may hinder their functionality, checking them for any defects, and then assembling the parts to form two complete umbilicals. They will be transported to Kennedy's Launch Equipment Test Facility where they will undergo testing to ensure their readiness to support operations leading up to launch.

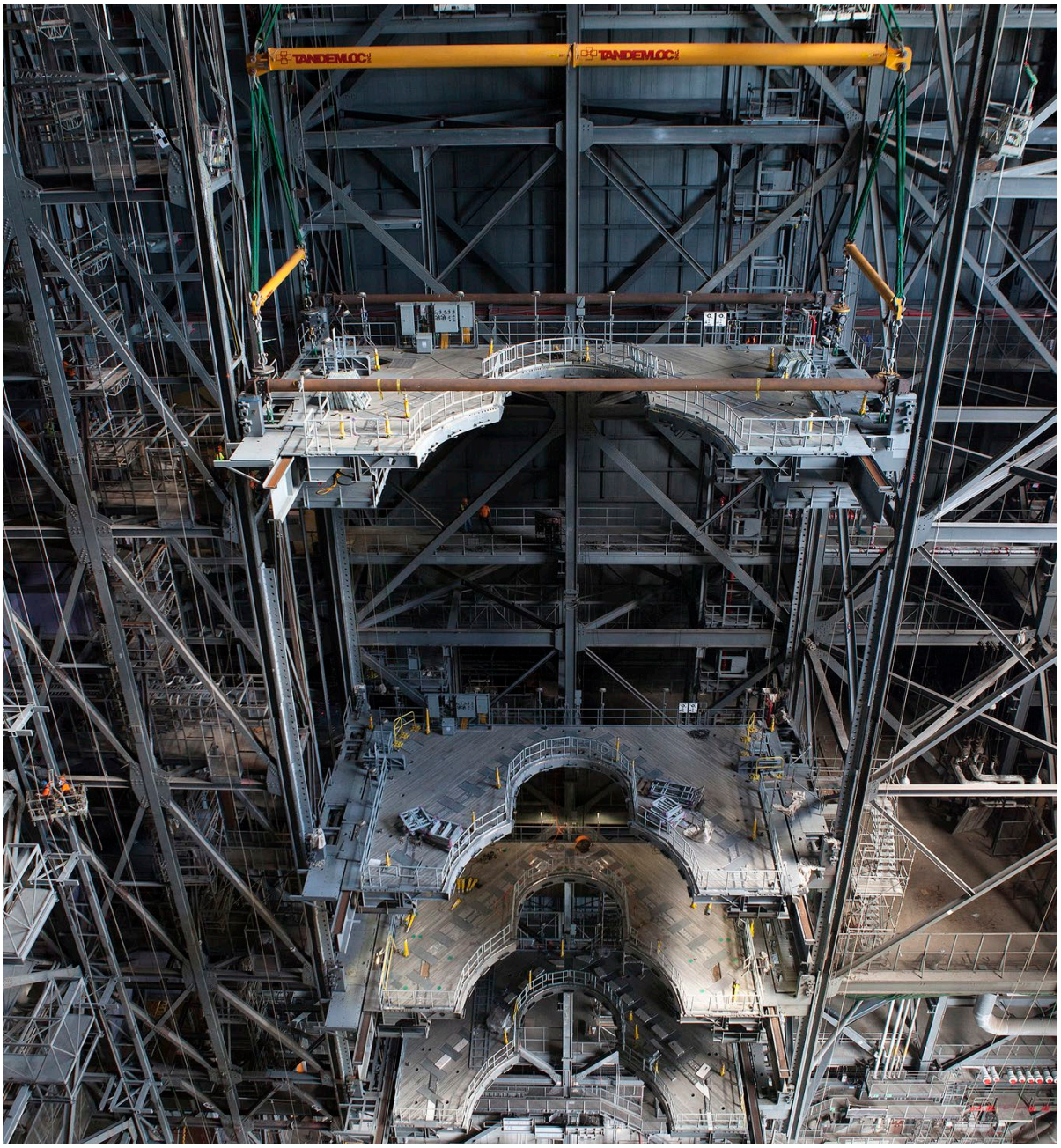
The umbilicals will connect from the zero-level deck on the base of the mobile launcher to the SLS rocket core stage aft section. The 33-foot-tall structures will provide liquid oxygen and liquid hydrogen fluid lines and electrical cable connections to the SLS core stage engine section to support propellant handling during prelaunch operations.

At the LETF, engineers and technicians will use liquid nitrogen to simulate the liquid oxygen for the TSMU that will provide liquid oxygen. They will test the umbilical's arm performance across the full range of SLS core stage motions and simulate a vehicle launch using the Vehicle Motion Simulator test fixture. The same series of tests will be performed with the second TSMU that will provide liquid hydrogen, using the actual liquid hydrogen commodity.

Before launch, both TSMUs will tilt back to ensure a safe and reliable disconnect and retract of all umbilical hardware away from the rocket during liftoff.

Kennedy's Engineering Directorate, along with the Ground Systems Development and Operations Program, are supporting processing activities of the umbilicals for missions to deep space including NASA's journey to Mars.

JUNE



JUNE

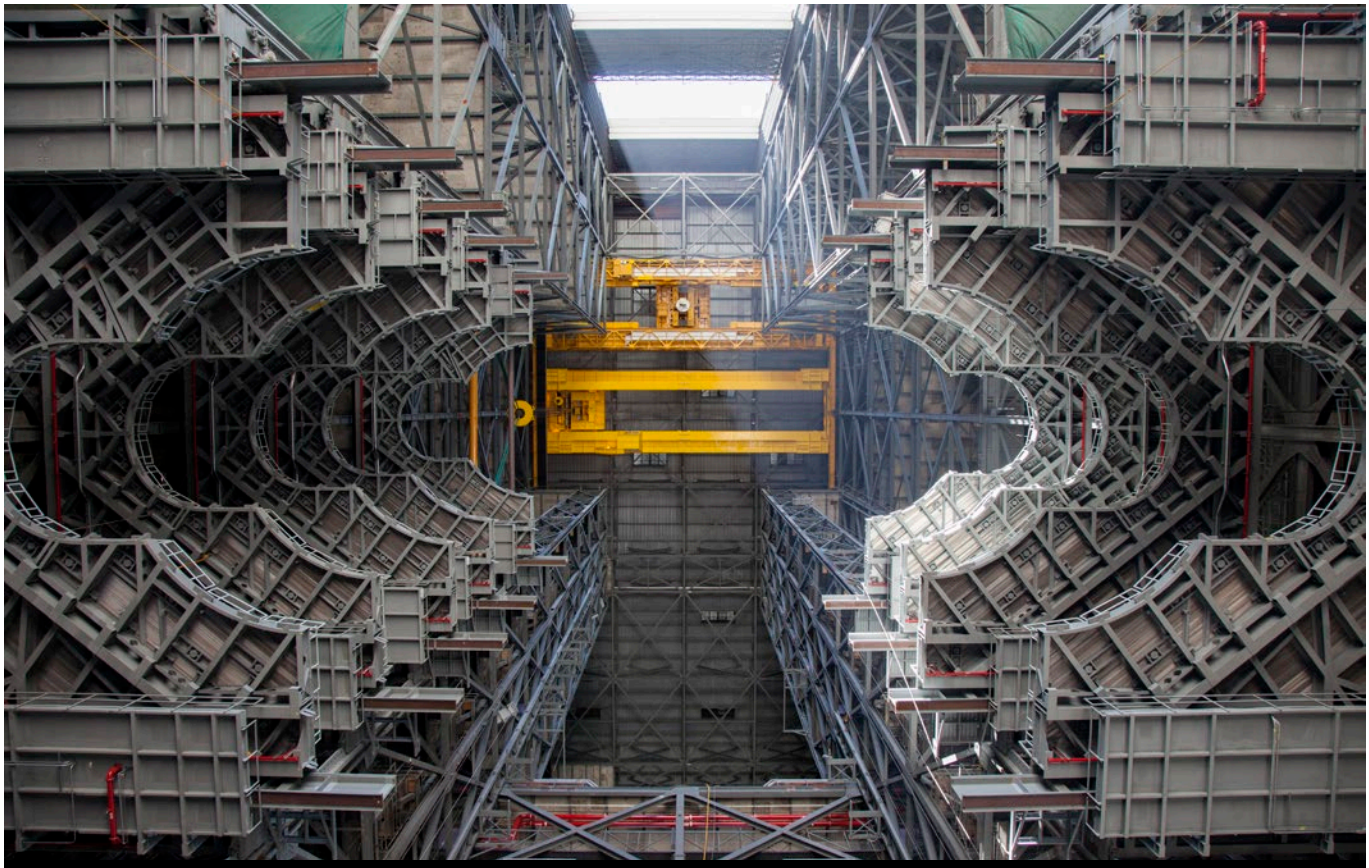
PLATFORM G NORTH LOWERED INTO PLACE IN HIGH BAY 3

On June 23, 2016, a heavy-lift crane lowers the second half of the G-level work platforms, G north, for NASA's Space Launch System (SLS) rocket, into position in High Bay 3 of the Vehicle Assembly Building (VAB) at NASA's Kennedy Space Center in Florida. A special tool called a Tandemloc helps keep the platform level as it is lowered. The second G-level platform will be installed on the north side of high bay, at about the 14th floor level. Previously installed work platforms, H, J, and K are in view below the G platform. The G-level work platforms are the fourth of 10 levels of work platforms that will surround and provide access to the SLS rocket and Orion spacecraft for Exploration Mission 1. The Ground Systems Development and Operations Program is overseeing upgrades and modifications to VAB High Bay 3, including installation of the new work platforms, to prepare for NASA's Journey to Mars. Photo credit: NASA/Kim Shiflett

FIRING ROOM SOFTWARE DEVELOPED

JUNE

The Ground Systems Development and Operations Program made progress on a new Launch Control Center Firing Room system level platform of software called Spaceport Command and Control System - Version 3, or SCCS 3.
The new software now hosts and enables the ground applications to run for non-hazardous testing at three facilities: Launch Pad 39B, the Launch Equipment Test Facility and the Multi-Payload Processing Facility.
Several tests using the ground software applications for command and control have occurred at the three facilities: the power systems and cryogenic hardware at Pad 39B, the ARMs and umbilicals at the LETF, and the pneumatic, cooling, electrical and hypergolic systems at the MPPF.
At the Launch Control Center, the master console software in Firing Room 1 was verified and ready for use to monitor network command and polling of data at all three facilities.



A heavy-lift crane lifts the first half of the F-level work platforms, F south, for NASA's Space Launch System (SLS) rocket, from the floor of the Vehicle Assembly Building (VAB) at Kennedy Space Center on July 15. Photo credit: NASA/Bill White

NASA REACHES PLATFORM MILESTONE AT KENNEDY SPACE CENTER FOR SPACE LAUNCH SYSTEM

Installation of new work platforms for NASA's Space Launch System (SLS) rocket and the journey to Mars reached the halfway point in July inside the Vehicle Assembly Building (VAB) at the agency's Kennedy Space Center in Florida. Prior to rolling out to the launch pad, the rocket and Orion spacecraft will come together in the VAB for processing and assembly. Five of the ten levels of platforms are in place in High Bay 3, all part of the massive amount of work going on inside the iconic building to accommodate SLS and Orion.

"This is a key milestone for NASA and the Ground Systems Development and Operations Program," said Mike Bolger, GSDO program manager at Kennedy.

The F North and South platforms were lifted by crane from the transfer aisle floor of the VAB, slowly raised into position, and attached to rail beams on the south and north walls of the high bay on July 15 and 19, respectively. The rail beams provide structural support and contain the drive mechanisms to retract and extend the platforms.

When all of the platforms are installed, a total of 10 levels of work platforms, 20 platform halves altogether, will surround the SLS rocket and Orion spacecraft and provide access for testing and processing for the uncrewed Exploration Mission 1 and deep-space missions, including the journey to Mars.

"This is a significant accomplishment in the production and installation of the platforms for High Bay 3," said Jose Perez Morales, VAB Element Project manager.

It takes about four hours to lift and install each of the platforms. They weigh between 300,000 and 325,000 pounds, and measure about 38 feet long and close to 62 feet wide. Construction workers with VAB general contractor Hensel Phelps, subcontractors S&R, Steel LLC and Sauer Inc., and the Kennedy Test and Operations Support Contract contractor Jacobs are performing the work.

"It's another giant leap for the GSDO Program as we prepare Kennedy Space Center to support the agency's journey to Mars," Bolger said.

To read the complete story, visit
http://www.nasa.gov/feature/nasa-reaches-platform-milestone-at-kennedy-space-center-for-space-launch-system

JULY

GROUND LAUNCH SEQUENCER SOFTWARE TESTED

JULY

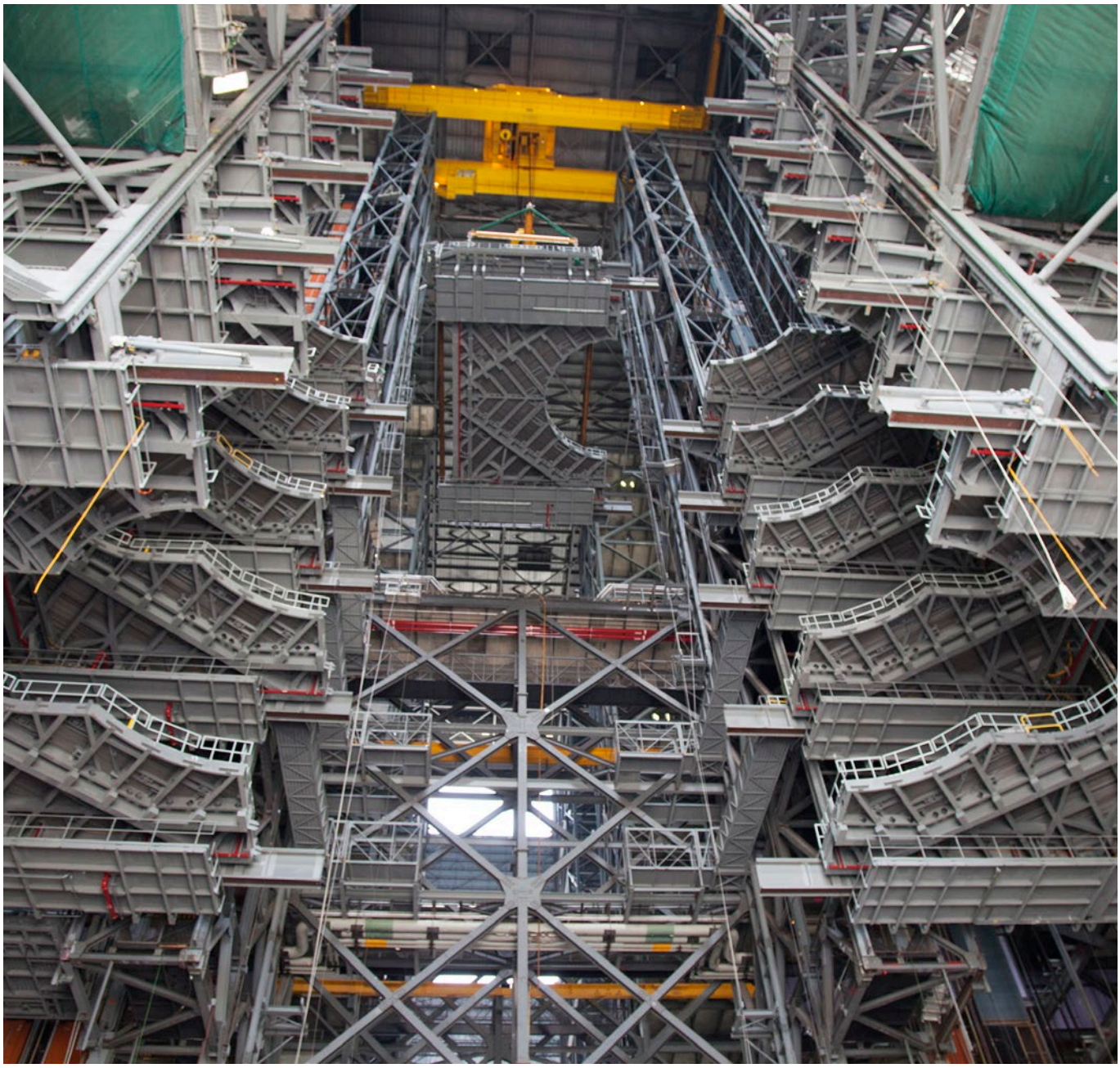
The first demonstration of the Ground Launch Sequencer (GLS) software for launch countdown took place in Firing Room 1 in the Launch Control Center in (month) 2016.

The software was developed by the Command, Control and Communications teams in the Ground Systems Development and Operations Program (GSDO) at NASA's Kennedy Space Center.

During the simulated countdown demonstration, a hold of the sequencer was initiated when fault detection occurred. After esolution of the anomaly, the software resumed successful countdown operations. The demonstration was viewed by Kennedy's senior management, including Center Director Bob Cabana, GSDO Program Manager Mike Bolger, and Launch Director Charlie Blackwell-Thompson.

The GLS will be used to sequence launch events for test flights of the Space Launch System rocket and Orion spacecraft.

AUGUST



FIRST HALF OF PLATFORM E INSTALLED IN HIGH BAY 3

A heavy-lift crane lowers the first half of the E-level work platforms, E south, for NASA's Space Launch System (SLS) rocket, into High Bay 3 in the Vehicle Assembly Building (VAB) at NASA's Kennedy Space Center in Florida on Aug. 26, 2016. In view are five levels of platforms previously installed. The E platform will be installed on the south side of High Bay 3, about 246 feet above the floor. The E platforms are the sixth of 10 levels of work platforms that will surround and provide access to the SLS rocket and Orion spacecraft for Exploration Mission 1. The Ground Systems Development and Operations Program is overseeing upgrades and modifications to VAB High Bay 3, including installation of the new work platforms, to prepare for NASA's Journey to Mars. Photo credit: NASA/Ben Smegelsky

AUGUST

FIRST HALF OF C PLATFORMS ARRIVES AT KENNEDY SPACE CENTER

A heavy load transport truck from Tillett Heavy Hauling in Titusville, Florida, arrives Aug. 4, 2016, at the Vehicle Assembly Building (VAB) at NASA's Kennedy Space Center in Florida, carrying a section of the first half of the C-level work platforms, C south, for the agency's Space Launch System (SLS) rocket. The platform will be delivered to the VAB staging area in the west parking lot. The Ground Systems Development and Operations Program is overseeing upgrades and modifications to VAB High Bay 3 to support processing of the SLS and Orion spacecraft. A total of 10 levels of new platforms, 20 platform halves altogether, will surround the SLS rocket and Orion spacecraft and provide access for testing and processing. Photo credit: NASA/Glen Benson

SEPTEMBER

One of two new 400-ton-plus capacity cooling towers arrives at Launch Pad 39B at NASA's Kennedy Space Center Florida. The two cooling towers will feed three new 180-ton-capacity chillers for the heating, venting and air conditioning system. Photo credit: NASA

LAUNCH PAD 39B INFRASTRUCTURE UPGRADES WILL SUPPORT NASA'S JOURNEY TO MARS

Launch Pad 39B at NASA's Kennedy Space Center in Florida is undergoing a metamorphosis from top to bottom to support the agency's Space Launch System (SLS) rocket with the Orion spacecraft atop for their first integrated uncrewed flight test. While modifications to the surface of the pad and ongoing work in the flame trench are visible, upgrades to other systems may not be as obvious, but are vital to ensuring safe and successful launches into deep space and NASA's Journey to Mars.

"We have been steadily working a series of projects to modernize or refurbish every part of the pad," said Regina Spellman, launch pad senior project manager in the Ground Systems Development and Operations (GSDO) Program. "Upon completion of this group of projects, we are entering the home stretch in our preparation for the first launch."

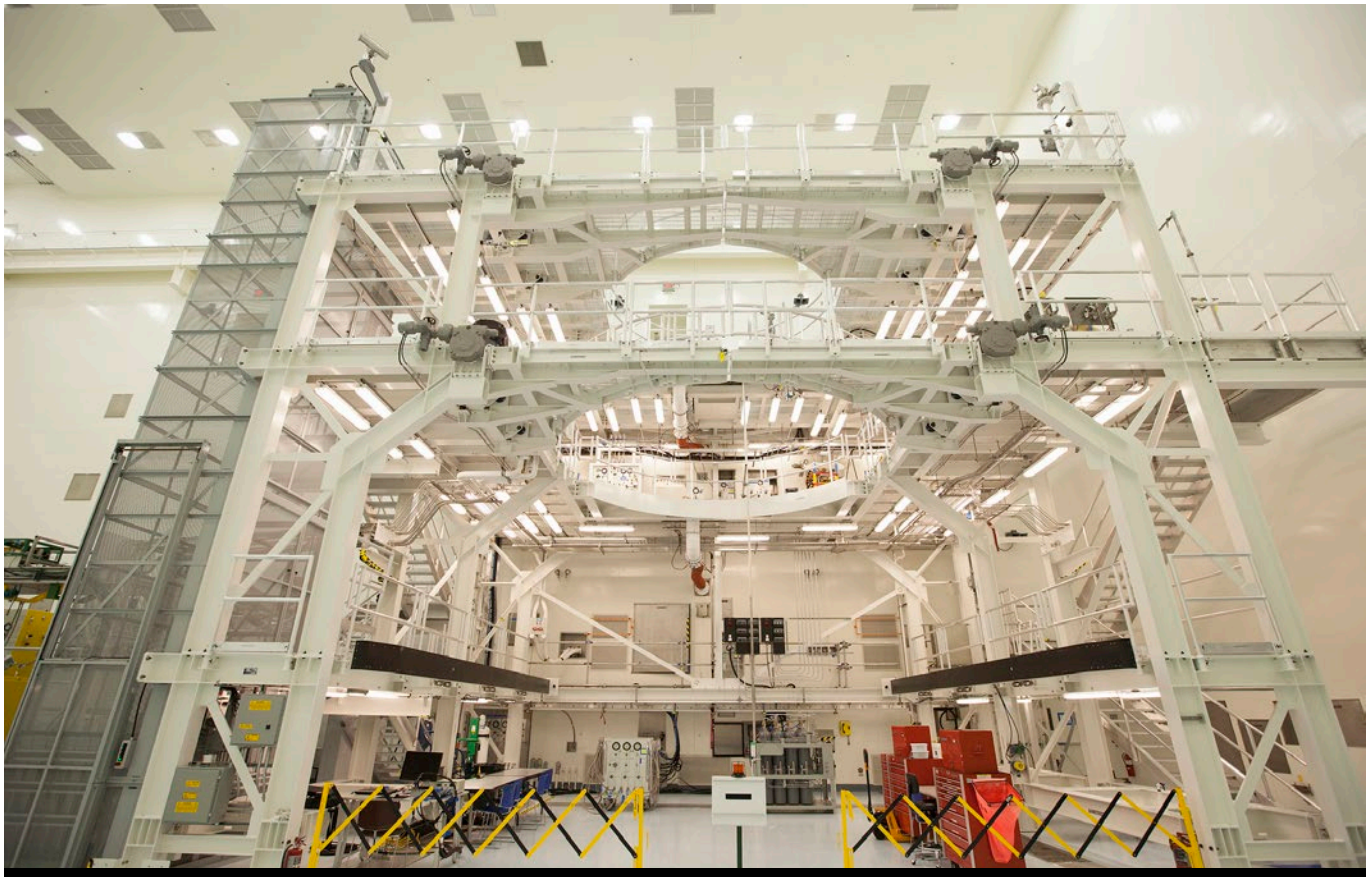
These upgrades include a new communication system; new heating, ventilation and cooling system; replacement of water system piping in the pad perimeter; and installing new ignition overpressure/sound suppression bypass valves at the valve complex. All of these improvements are necessary to support pad prelaunch processing and launch requirements for SLS and the Orion.

"There is a feeling of excitement starting to build as Pad B nears being operational once again," said Lori Jones, an engineer and project manager for Construction of Facilities for the pad.

GSDO is overseeing upgrades to Pad 39B and other facilities to support NASA's deep-space missions and the transition to a multi-user spaceport.

Read the full story at:
http://www.nasa.gov/feature/launch-pad-39b-infrastructure-upgrades-will-support-nasa-s-journey-to-mars

SEPTEMBER



The Orion service platform will be used for offline processing and fueling of the Orion spacecraft and service module stack before launch. Modifications now are complete with validations and testing underway. Photo credit: NASA/Ben Smegelsky

MULTI-PAYLOAD PROCESSING FACILITY PROVIDES 'GAS STATION' FOR ORION

The first stop when loading up the family car to go on a long trip usually is the gas station. Before NASA's Orion spacecraft launches on deep-space missions, an important step to "fill 'er up" will include a visit to the Multi-Payload Processing Facility (MPPF) at the agency's Kennedy Space Center in Florida.

At the MPPF, Orion will receive its flight load of propellant, high pressure gases and coolant in a building where recently completed modifications now are being tested.

"After years of design work and installation of state-of-the-art equipment, we now are testing elements of the facility," said Skip Williams, project manager for the spacecraft offline element integration team. "This is the validation and verification phase to make sure we're ready when Orion's crew module (CM) and its service module (SM) arrive before EM-1."

Orion's first flight with the Space Launch System (SLS) rocket is targeted for launch in late 2018. During the three-week mission, the spacecraft will venture 40,000 miles beyond the orbit of the moon, farther than any spacecraft built for humans has ever traveled, testing the systems needed for the agency's Journey to Mars.

The 19,647-square-foot MPPF originally was constructed in 1995. True to its name, the facility can accommodate one or more payloads in processing at the same time depending on their size.

An example of the MPPF's abilities included payload processing for space shuttle missions STS-95 and STS-88. Also, prior to STS-99, the large Shuttle Radar Topography Mission payload was tested and verified, occupying more than 95 percent of the facility's high bay space.

Design work to support Orion began in 2007. The Boeing Design Lab helped develop the complex, integrated engineering strategy for the facility.

The extensive upgrades and modernizations began in 2013. It was a part of Kennedy's Ground Systems Development and Operations Program's overall effort to build a premier, multi-user spaceport.

"Just about everything in the building from the floor to the ceiling was modified to support Orion," said Leo DeCesare, Construction of Facilities project manager in Kennedy Engineering.

Read the full story at: http://www.nasa.gov/feature/multi-payload-processing-facility-provides-gas-station-for-orion

OCTOBER

ORION SERVICE MODULE UMBILICAL TESTING WRAPS UP AT LAUNCH EQUIPMENT TEST FACILITY

Testing of the Orion Service Module Umbilical (OSMU) was completed at the Launch Equipment Test Facility at NASA's Kennedy Space Center in Florida. The OSMU was attached to Vehicle Motion Simulator 1 for a series of simulated launch tests to validate it for installation on the mobile launcher.

The mobile launcher tower will be equipped with a number of lines, called umbilicals, that will connect to the Space Launch System rocket and Orion spacecraft for Exploration Mission 1 (EM-1). The OSMU will be located high on the mobile launcher tower and, prior to launch, will transfer liquid coolant for the electronics and air for the Environmental Control System to the Orion service module that houses these critical systems to support the spacecraft.

Kennedy's Engineering Directorate is providing support to the Ground Systems Development and Operations Program for testing of the OSMU. EM-1 is scheduled to launch in 2018. Photo credit: NASA/Ben Smegelsky

U.S. Navy divers and other personnel in a small Zodiac boat secure a tether line to an attach point on a test version of the Orion crew module Oct. 31 during Underway Recovery Test 5 in the Pacific Ocean off the coast of California. Photo credit: NASA/Bill White

NASA, U.S. NAVY PRACTICE ORION RECOVERY PROCEDURES

OCTOBER

When Orion returns from deep space missions and lands in the ocean, a team will be responsible for safely returning the capsule and crew back to land. That feat will be accomplished by a landing and recovery group that includes NASA and contractor engineers and technicians and U.S. Navy divers, along with a variety of water vessels and ground support equipment.

NASA's Ground Systems Development and Operations Program (GSDO), the U.S. Navy, U.S. Air Force and contractor employees recently wrapped up in late October a successful rehearsal of Orion recovery, called an Underway Recovery Test, aboard the USS San Diego in the Pacific Ocean off the coast of California.

The USS San Diego is an amphibious ship with a landing platform/dock used to pull the Orion spacecraft into the ship, and underway is a U.S. Navy term meaning that the ship is out to sea. This is the fifth such test with Orion, and previous underway recovery tests have helped contribute to the team's understanding of how to adjust for various water conditions and contingency scenarios.

"Our Orion recovery testing was our first chance to field test new ground support equipment and operational procedures," said Mike Bolger, GSDO director at Kennedy Space Center in Florida.

During the recovery test, the team demonstrated and evaluated in open water new recovery processes, procedures, hardware and personnel that will be necessary to recover the Orion crew module into the well deck of a Navy ship based on what was learned during Orion's flight test in December 2014. New ground support equipment testing included attaching tow lines to five attach points, rather than three, on the crew module. Also, tow cleat assemblies were modified to include a tow pin insert that allows easier tow line connections in rocky waves.

The recovery team headed out to sea aboard the ship, along with a test version of the Orion crew module and recovery support equipment secured in the ship's well deck. During a series of tests over several days, the well deck was flooded with water and the test vehicle was allowed to float out to open water to rehearse various segments of recovery procedures, including attaching a collar and various lines on the module and pulling, or guiding it back into the ship.

Read the full story at http://go.nasa.gov/2fxKTgD

OCTOBER

LAUNCH PAD 39B FLAME TRENCH UPGRADES

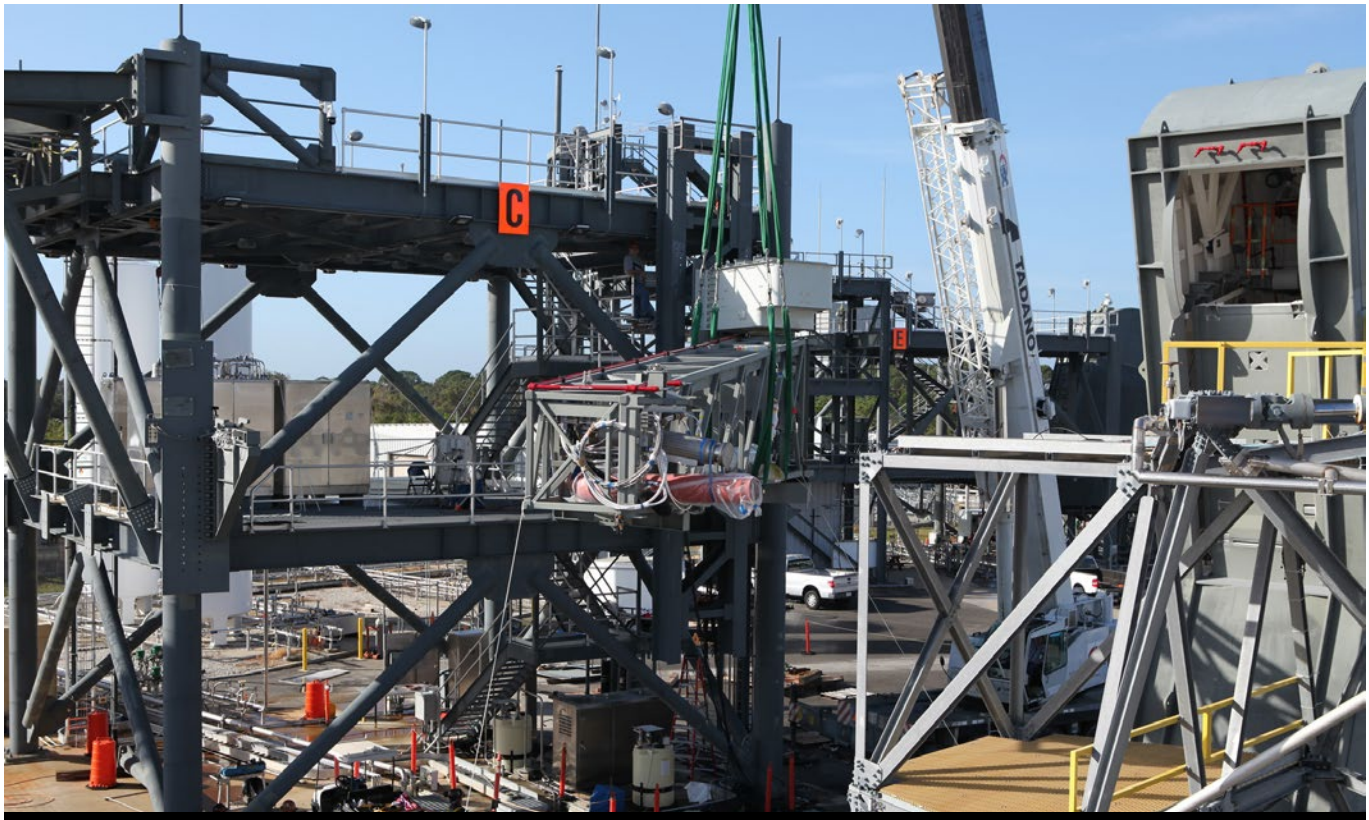
Progress continues on the new flame trench at Launch Pad 39B at NASA's Kennedy Space Center in Florida. Construction workers with J.P. Donovan of Rockledge, Florida, are on an elevated work stand to install new heat-resistant bricks on the north side of the flame trench. The Pad B flame trench is being refurbished to support the launch of NASA's Space Launch System rocket. The Ground Systems Development and Operations (GSDO) Program at Kennedy is helping transform the space center into a multi-user spaceport and prepare for Exploration Mission 1, deep space missions and NASA's Journey to Mars. Photo credit: NASA/Kim Shiflett

AFT SKIRTS READY FOR ASSEMBLY

NOVEMBER

The right-hand aft skirt for NASA's Space Launch System (SLS) rocket has been refurbished and painted and is ready for the assembly process in the Booster Fabrication Facility at the agency's Kennedy Space Center in Florida. The right and left aft skirts were refurbished and painted in support facilities at Hangar AF at Cape Canaveral Air Force Station in Florida. The space shuttle-era aft skirt will be used on the right-hand booster of the SLS for Exploration Mission 1 (EM-1). NASA is preparing for EM-1, deep space missions, and the Journey to Mars. Photo credit: Kim Shiflett

NOVEMBER



A crane lifts the Core State Inter-tank Umbilical (CSITU) for NASA's Space Launch System (SLS) on Nov. 30, 2016, at the Launch Equipment Test Facility at the agency's Kennedy Space Center in Florida. The CSITU was attached to the "C" tower of the Vehicle Motion Simulator 2 test fixture. The umbilical will undergo a series of tests to confirm it is functioning properly and ready to support the SLS rocket for launch. Photo credit: NASA/Dimitri Gerondidakis

SPACE LAUNCH SYSTEM CORE STAGE UMBILICAL READY FOR TESTS AT LAUNCH EQUIPMENT TEST FACILITY

Testing of several of the umbilical lines that will attach to NASA's Space Launch System (SLS) rocket from the tower on the mobile launcher continues at the Launch Equipment Test Facility (LETF) at Kennedy Space Center in Florida.

The Core Stage Inter-tank Umbilical (CSITU) arrived at the LETF and was attached to the "C" tower of the Vehicle Motion Simulator 2 test fixture. Engineers with the Ground Systems Development and Operations Program and the Engineering Directorate will prepare the umbilical for a series of tests to confirm it is functioning properly and ready to support the SLS rocket for launch.

The tests will begin in January 2017 and are scheduled to be completed by the end of February. Testing will include hydraulic system controller tuning, umbilical plate mate and leak checks, primary and secondary disconnect testing at ambient temperatures, and fire suppression system functional checks.

Also, a series of primary and secondary disconnect testing at liquid nitrogen and liquid hydrogen temperatures, minus 321 and minus 421 degrees Fahrenheit, respectively, will be performed.

The CSITU is a swing arm umbilical that will connect to the SLS core stage inter-tank. The umbilical's main function is to vent gaseous hydrogen from the core stage. The arm also provides conditioned air, pressurized gases, and power and data connection to the core stage.

The CSITU will be located at about the 140-foot level on the mobile launcher tower, between the Core Stage liquid hydrogen and liquid oxygen tanks, and will swing away before launch. The umbilical is one of several umbilicals that will be installed on the mobile launcher tower and attach to the SLS rocket and Orion spacecraft.

The Orion spacecraft is scheduled to launch in late 2018 atop the SLS rocket on a three-week mission that will take it thousands of miles beyond the moon and back during Exploration Mission 1.

NOVEMBER

A new liquid hydrogen separator tank arrives Nov. 17 at NASA's Kennedy Space Center in Florida. A crane is used to lift the tank and rotate it before it is delivered to Launch Pad 39B. Photo credit: NASA/Kim Shiflett

NEW LIQUID HYDROGEN TANK WILL SUPPORT FLIGHTS FROM LAUNCH PAD 39B

A new liquid hydrogen (LH2) liquid separator tank arrived at NASA's Kennedy Space Center in Florida. It will be used to support the agency's Space Launch System rocket and all future launches from Launch Pad 39B.

The tank was lifted by crane, rotated, and then lowered on the transporter for the move to the pad.

The existing hydrogen vent system that terminates at a flare stack was designed for gaseous hydrogen. New requirements for Exploration Mission 1 and future launches include the need to address liquid hydrogen in the vent system. The new LH2 separator/storage tank will be added to the existing hydrogen vent system to assure gaseous hydrogen is delivered downstream to the flare stack.

At Pad B, the existing hydrogen vent line and supporting systems will be modified to accommodate the new LH2 liquid separator tank. The Ground Systems Development and Operations Program and the Engineering Directorate at Kennedy are performing the upgrades to Launch Pad 39B to support the agency's premier multi-user spaceport.

The 60,000 gallon tank was built by INOXCVA, in Baytown, Texas, a subcontractor to Precision Mechanical Inc. in Cocoa, Florida. It is about 56 feet long, with a 14-foot diameter.

DECEMBER

A heavy-lift crane lowers the first half of the B-level work platforms, B south, for NASA's Space Launch System (SLS) rocket, for installation Dec. 2 on the south side of High Bay 3 in the Vehicle Assembly Building (VAB) at NASA's Kennedy Space Center in Florida. Large Tandemloc bars have been attached to the platform to keep it level during lifting and installation. In view below are eight levels of previously installed platforms. The B platforms are the ninth of 10 levels of work platforms that will surround and provide access to the SLS rocket and Orion spacecraft for Exploration Mission 1. The Ground Systems Development and Operations Program is overseeing upgrades and modifications to VAB High Bay 3, including installation of the new work platforms, to prepare for NASA's Journey to Mars. Photo credit: NASA/Dimitri Gerondidakis

DECEMBER

SECOND HALF OF B PLATFORMS INSTALLED IN HIGH BAY 3

High up in the Vehicle Assembly Building (VAB) at NASA's Kennedy Space Center in Florida, a crane lowers the second half of the B-level work platforms, B north, for NASA's Space Launch System (SLS) rocket, for installation in High Bay 3 on Dec. 16, 2016. The B platform was installed on the north side of high bay. In view below are eight levels of previously installed platforms. The B platforms are the ninth of 10 levels of work platforms that will surround and provide access to the SLS rocket and Orion spacecraft for Exploration Mission 1. The Ground Systems Development and Operations Program is overseeing upgrades and modifications to VAB High Bay 3, including installation of the new work platforms, to prepare for NASA's Journey to Mars. Photo credit: NASA/Ben Smegelsky

The Orion Underway Recovery Test 5 (URT-5) team celebrate a successful test during a gathering hosted by the Ground Systems Development and Operations Program and the Engineering Directorate at NASA's Kennedy Space Center in Florida. Photo credit: NASA/Ben Smegelsky

TEAM CELEBRATES SUCCESS OF ORION UNDERWAY RECOVERY TEST 5

The Orion Underway Recovery Test 5 (URT-5) team recently celebrated the completion of the test during a gathering hosted by the Ground Systems Development and Operations Program (GSDO) and the Engineering Directorate at NASA's Kennedy Space Center in Florida. URT-5 team members included NASA's GSDO, Kennedy's Engineering Directorate, contractors with the Test and Operations Support Contract and Engineering Services Contract, Orion representatives, the team from the Neutral Buoyancy Laboratory at Johnson Space Center in Houston, and U.S. Air Force Detachment 3 from the 45th Space Wing at nearby Patrick Air Force Base.

During URT-5 in October, the team practiced recovering a test version of the Orion crew module in the Pacific Ocean, off the coast of California, and guiding it into the well deck of the USS San Diego. Over several days, the team demonstrated and evaluated new recovery processes, procedures, hardware and personnel that will be necessary to recover Orion after its first flight test on NASA's Space Launch System (SLS) rocket.

"URT-5 proved to be a really valuable test for us as we evolve our ground support equipment and recovery procedures to one day safely recover our astronauts and crew module from deep space," said Mike Bolger, GSDO Program manager. "It is a complex procedure and the conditions on the Pacific Ocean can be daunting. But this team performed flawlessly."

Landing and Recovery Director Melissa Jones, with GSDO, thanked the team for countless hours of hard work and hundreds of newly developed parts that contributed to the success of the test.

"This test was the first time the Landing and Recovery Team has been able to consistently demonstrate control of the test capsule in the well deck of the ship," Jones said.

The team will fine-tune their strategy, make some equipment adjustments and return to the open water for another test late next year.

NASA's Orion spacecraft is scheduled to launch atop the SLS on Exploration Mission 1 in late 2018. EM-1 will send Orion on a path thousands of miles beyond the moon over a course of three weeks, farther into space than human spaceflight has ever traveled before. The spacecraft will return to Earth and safely splash down in the Pacific Ocean. The mission will advance and validate capabilities required for the Journey to Mars.

National Aeronautics and Space Administration

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